The Impact of the El Niño-Southern Oscillation and Atlantic Meridional Mode on Atlantic Tropical Cyclone Activity

Christina M. Patricola [1], R. Saravanan [1], Ping Chang [2,1]

1: Department of Atmospheric Sciences, Texas A&M University, College Station, Texas
2: Department of Oceanography, Texas A&M University, College Station, Texas

The El Niño-Southern Oscillation (ENSO) and Atlantic Meridional Mode (AMM) strongly influence Atlantic tropical cyclone (TC) activity, with warm ENSO and cool AMM phases inhibiting TCs, and vice versa. The impact of concurrent strong phases of ENSO and AMM in modulating Atlantic TC activity is investigated. The response of the atmospheric environment relevant for TCs is evaluated with the genesis potential index of Emanuel and Nolan.

Composites of observed Atlantic accumulated cyclone energy (ACE) suggest ENSO and AMM can amplify or dampen the influence of one another on Atlantic TCs. To supplement the observational analysis, we performed simulations using a 27-km resolution regional climate model (WRF). The control simulation uses observed sea surface temperature (SST) and lateral boundary conditions (LBCs) of 1980-2000. Mechanistic experiments are forced with ENSO phases through LBCs and eastern tropical Pacific SST and AMM phases through Atlantic SST.

Simultaneous strong El Niño and strongly positive AMM, as well as concurrent strong La Niña and strongly negative AMM, produce near-average Atlantic ACE suggesting compensation between the two influences which individually oppose each other in their impact on Atlantic TCs, consistent with the observational analysis. Strong La Niña and strongly positive AMM together produce extremely intense Atlantic TC activity, supported by considerable mid-tropospheric humidity increases and marginally reduced wind shear and increased potential intensity. The model and observations suggest the upper limit of seasonal Atlantic TC activity requires both La Niña and positive AMM.